WHAT IS CLAIMED IS:

1. A light concentrator, comprising:

at least one core;

at least one adjacent material that has a lower index of refraction than the core and that is in contact with at least a portion of a surface of the core;

a plurality of nanostructures, wherein the nanostructures absorb light impinging on a surface of the concentrator and emit light, and wherein the nanostructures are located or orientated within the concentrator such that the fraction of the light emitted by the nanostructures that is waveguided by the at least one core is greater than $\frac{1}{2}*(\cos(\mathrm{asin}(n_1/n_2))-\cos(\mathrm{pi}-\mathrm{asin}(n_1/n_2)))$, where n_1 is the refractive index of the adjacent material and n_2 is the refractive index of the core; and,

at least one collector which collects the waveguided light, the collector being operably connected to the core.

2. A light concentrator as in claim **1**, wherein at least 1%, at least 10%, or at least 50% of the total nanostructures are located or orientated within the concentrator such that greater than $\frac{1}{2}*(\cos(\mathrm{asin}(n_1/n_2))-\cos(\mathrm{pi}-\mathrm{asin}(n_1/n_2)))$, where n_1 is the refractive index of the adjacent material and n_2 is the refractive index of the core, of the light emitted by the nanostructures is waveguided by the at least one core.

3. A light concentrator, comprising:

at least one core;

a cladding having a lower index of refraction than the core; and

a plurality of nanowires, which nanowires absorb light impinging on a surface of the concentrator and emit light, and which nanowires are oriented substantially nonrandomly within the core, with a vector average of the nanowires' orientations having a nonzero component perpendicular to a surface of the core, whereby the fraction of the light emitted by the nanowires that is waveguided by the at least one core is greater than $\frac{1}{2}*(\cos(\mathrm{asin}(n_1/n_2))-\cos(\mathrm{pi}-\mathrm{asin}(n_1/n_2)))$, where n_1 is the refractive index of the cladding and n_2 is the refractive index of the core.

4. A light concentrator as in claim **3**, wherein at least 1%, at least 10%, or at least 50% of the total nanowires within the core are substantially nonrandomly oriented.

5. A light concentrator as in claim **3**, wherein at least one collector which collects the waveguided light is operably connected to the core.

6. A light concentrator, comprising:

at least one core; and

a first layer comprising one or more nanostructures, which one or more nanostructures absorb light impinging on a surface of the concentrator and emit light, and which first layer is disposed on a surface of the core, such that the fraction of the light emitted by the nanostructures that is waveguided by the at least one core is greater than $\frac{1}{2}*(\cos(\mathrm{asin}(n_1/n_2))-\cos(\mathrm{pi}-\mathrm{asin}(n_1/n_2)))$, where n_1 is the refractive index of the first layer and n_2 is the refractive index of the core.

7. A light concentrator as in claim **6**, wherein the one or more nanostructures comprise a plurality of nanowires, which nanowires are substantially nonrandomly oriented, with a vector average of the nanowires' orientations having a nonzero component perpendicular to the surface of the core.

8. A light concentrator as in claim **7**, wherein at least 1%, at least 10%, or at least 50% of the total nanowires disposed on the core are substantially nonrandomly oriented.

9. A light concentrator as in claim **6**, wherein the orientation of the one or more nanostructures is random.

10. A light concentrator as in claim **6**, wherein at least one collector which collects the waveguided light is operably connected to the core.

11. A waveguide, comprising:

a cladding; and

a core, the core having a first surface and a second surface that are substantially parallel to each other, the core having a higher index of refraction than the cladding, the core comprising one or more nanowires or one or more branched nanowires and a matrix, and the core being in contact with the cladding over at least a majority of the first and second surfaces of the core.

12. A waveguide as in claim **11**, wherein the one or more branched nanowires comprise one or more nanotetrapods.

13. A waveguide as in claim **11**, wherein the cladding is air.

14. A waveguide as in claim **11**, wherein the waveguide is a flat sheet.

15. A waveguide as in claim **11**, wherein the core has an index of refraction between about 1.35 and about 4.

16. A waveguide as in claim **11**, wherein the matrix is substantially nonabsorbing and nonscattering with respect to light at wavelengths greater than about 300 nm.

17. A waveguide as in claim **11**, wherein the matrix comprises a glass, a polymer, a small molecule or molecular matrix, a liquid, a crystal, or a polycrystal.

18. A waveguide as in claim **11**, wherein the one or more nanowires have an average diameter between about 2 nm and about 100nm or between about 2 nm and about 20 nm.

19. A waveguide as in claim **11**, wherein the one or more nanowires have an aspect ratio between about 1.5 and about 100, or between about 5 and about 30.

20. A waveguide as in claim **11**, wherein the waveguide comprises a plurality of nanowires.

21. A waveguide as in claim **20**, wherein the orientation of the nanowires is substantially nonrandom, with a vector average of the nanowires' orientations having a nonzero component perpendicular to the first surface of the core.

22. A waveguide as in claim **21**, wherein at least 1%, at least 10%, or at least 50% of the total nanowires within the core are substantially nonrandomly oriented.

23. A waveguide as in claim **21**, wherein a majority of the nanowires each has a long axis oriented more nearly perpendicular than parallel to the first surface of the core.

24. A waveguide as in claim **21**, wherein the plurality of nanowires form a liquid crystal phase in which each nanowire has a long axis oriented substantially normal to the first surface of the core.

25. A waveguide as in claim **20**, wherein the nanowires absorb light impinging on the first or second surface of the core and emit light, and wherein the nanowires are oriented within the core such that a majority of the light emitted from the nanowires is emitted at an angle greater than the critical angle Θ_{crit}, where $\Theta_{crit}=\sin^{-1}(n_r/n_i)$, n_r is the index of refraction of the cladding, and n_i is the index of refraction of the core, thereby directing a majority of the emitted light toward at least one edge of the core, providing a light concentrator.

26. A waveguide as in claim **11**, wherein the one or more nanowires or one or more branched nanowires comprise one or more of: a fluorescent material, a semiconducting material, a material comprising a first element selected from group 2 of the periodic table and a second element selected from group 16, a material comprising a first element selected from group 12 and a second element selected from group 16, a material comprising a first element selected from group 13 and a second element selected from group 15, a material comprising a group14 element, or an alloy or a mixture thereof.

27. A waveguide as in claim **26**, wherein the one or more nanowires or one or more branched nanowires comprise one or more of: ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, MgS, MgSe, MgTe, CaS, CaSe, CaTe, SrS, SrSe, SrTe, BaS, BaSe, BaTe, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, Ge, Si, PbS, PbSe, PbTe, AlS, AlP, AlSb, or an alloy or a mixture thereof.

28. A waveguide as in claim **11**, wherein the one or more nanowires or one or more branched nanowires comprise one or more materials, each material having a band-gap energy between about 0.4 eV and about 4.1 eV.

29. A waveguide as in claim **11**, wherein the one or more nanowires or one or more branched nanowires are heterostructures comprising at least two different materials.

30. A waveguide as in claim **29**, wherein the at least two materials are distributed radially about a long axis of the one or more nanowires or about a long axis of an arm of the one or more branched nanowires.

31. A waveguide as in claim **11**, wherein at least one collector which collects waveguided light is operably connected to at least one edge of the core.

32. A multilayer light concentrator comprising: a stack comprising two or more waveguides as described in claim **11**.

33. A multilayer light concentrator as described in claim **32**, wherein the two or more waveguides comprise one or more nanowires or one or more branched nanowires that absorb light of different wavelengths, and wherein the waveguide comprising the one or more nanowires or one or more branched nanowires that absorb the shortest wavelength light is located closest to a light source and the waveguide comprising the one or more nanowires or one or more branched nanowires that absorb the longest wavelength light is located farthest from the light source.

34. A waveguide, comprising:

a first core having a first surface and a second surface, the first and second surfaces being substantially parallel to each other;

a first layer comprising one or more nanostructures, wherein the one or more nanostructures are selected from the group consisting of nanowires, nanocrystals, branched nanowires, or nanotetrapods, the first layer being distributed on the first surface of the first core, the first layer having a first surface and a second surface; and

a cladding, the cladding having a first portion that is distributed on the second surface of the first core and having a second portion that is distributed on the first surface of the first layer.

35. A waveguide as in claim **34**, wherein the second surface of the first layer is in contact with at least a majority of the first surface of the first core, the first portion of the cladding is in contact with at least a majority of the second surface of the first core, and the second portion of the cladding is in contact with at least a majority of the first surface of the first layer.

36. A waveguide as in claim **35**, wherein the one or more nanostructures absorb light impinging on a surface of the waveguide and emit light, wherein a majority of the light is emitted into the first core at an angle greater than the critical angle Θ_{crit}, wherein

$\Theta_{crit} = \sin^{-1}(n_r/n_i)$,

and wherein n_r is the index of refraction of the first layer, and n_i is the index of refraction of the first core, thereby directing a majority of the emitted light toward at least one edge of the substrate, providing a light concentrator.

37. A waveguide as in claim **34**, further comprising a second core, the second core having two substantially parallel surfaces, and the second core located between the first layer and the second portion of the cladding.

38. A waveguide as in claim **37**, wherein the first core and second core comprise the same material.

39. A waveguide as in claim **37**, further comprising:

a second layer located between the second core and the first layer; and

a third layer located between the first layer and the first core,

wherein the second layer and the third layer have an index of refraction greater than the index of refraction of the first layer and less than the index of refraction of the first and second cores.

40. A waveguide as in claim **34**, wherein the one or more nanostructures are in a small molecule or molecular matrix or a matrix comprising at least one polymer or glass.

41. A waveguide as in claim **40**, wherein the matrix comprising at least one polymer comprises polydimethylsiloxane.

42. A waveguide as in claim **40**, wherein the first layer has an index of refraction that is less than the index of refraction of the first core.

43. A waveguide as in claim **34**, wherein the first layer consists of a plurality of substantially pure nanostructures.

44. A waveguide as in claim **34**, wherein the cladding is air.

45. A waveguide as in claim **34**, wherein the waveguide is a flat sheet.

46. A waveguide as in claim **34**, wherein the first core has an index of refraction between about 1.35 and about 4.

47. A waveguide as in claim **34**, wherein the first core is substantially nonabsorbing and nonscattering with respect to light at wavelengths greater than about 300 nm.

48. A waveguide as in claim **34**, wherein the first layer is substantially nonscattering with respect to light at wavelengths greater than about 300 nm, the nanostructures absorb light impinging on the first or second surface of the first core and emit light, and the first layer is substantially nonabsorbing with respect to the wavelength or wavelengths of light emitted by the nanostructures.

49. A waveguide as in claim **34**, wherein the first core comprises a glass, a polymer, a small molecule or molecular matrix, a liquid, a crystal, or a polycrystal.

50. A waveguide as in claim **34**, wherein the nanowires have an average diameter between about 2 nm and about 100nm or between about 2 nm and about 20 nm.

51. A waveguide as in claim **34**, wherein the nanocrystals have an average diameter between about 1.5 nm and about 15 nm.

52. A waveguide as in claim **34**, wherein the nanowires have an aspect ratio between about 1.5 and about 100, or between about 5 and about 30.

53. A waveguide as in claim **34**, wherein the nanocrystals have an aspect ratio between about 1 and about 1.5.

54. A waveguide as in claim **34**, wherein the one or more nanostructures comprise one or more of: a fluorescent material, a semiconducting material, a material comprising a first element selected from group 2 of the periodic table and a second element selected from group 16, a material comprising a first element selected from group 12 and a second element selected from group 16, a material comprising a first element selected from group 13 and a second element selected from group 15, a material comprising a group14 element, or an alloy or a mixture thereof.

55. A waveguide as in claim **54**, wherein the one or more nanostructures comprise one or more of: ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, MgS, MgSe, MgTe, CaS, CaSe, CaTe, SrS, SrSe, SrTe, BaS, BaSe, BaTe, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, Ge, Si, PbS, PbSe, PbTe, AlS, AlP, AlSb, or an alloy or a mixture thereof.

56. A waveguide as in claim **34**, wherein the one or more nanostructures comprise one or more materials, each material having a band-gap energy between about 0.4 eV and about 4.1 eV.

57. A waveguide as in claim **34**, wherein the one or more nanostructures are heterostructures comprising at least two different materials.

58. A waveguide as in claim **34**, wherein the at least two materials are distributed radially about a long axis of the one or more nanowires, a long axis of an arm of the one or more branched nanowires, a long axis of an arm of the one or more nanotetrapods, or a center of the one or more nanocrystals.

59. A waveguide as in claim **34**, wherein the one or more nanostructures comprise a plurality of nanostructures.

60. A waveguide as in claim **34**, wherein the waveguide comprises a plurality of nanowires, and wherein the orientation of the nanowires is substantially nonrandom, with a vector average of the nanowires' orientations having a nonzero component perpendicular to the first surface of the first core.

61. A waveguide as in claim **60**, wherein at least 1%, at least 10%, or at least 50% of the total nanowires within the first layer are substantially nonrandomly oriented.

62. A waveguide as in claim **60**, wherein the majority of the nanowires each has a long axis oriented more nearly perpendicular than parallel to the first surface of the first core.

63. A waveguide as in claim **62**, wherein the nanowires form a liquid crystal phase in which each nanowire has a long axis oriented substantially normal to the first surface of the first core.

64. A waveguide as in claim **36**, wherein the first layer has a thickness less than about one wavelength of the light emitted by the one or more nanostructures.

65. A waveguide as in claim **34**, wherein the first layer has a thickness less than about 1000 nm, less than about 900 nm, less than about 800 nm, less than about 700 nm, less than about 600 nm, less than about 500 nm, or less than about 400 nm.

66. A waveguide as in claim **34**, wherein at least one collector which collects waveguided light is operably connected to at least one edge of the first core.

67. A multilayer light concentrator comprising: a stack comprising two or more waveguides as described in claim **34**.

68. A multilayer light concentrator as described in claim **67**, wherein the two or more waveguides comprise one or more nanostructures that absorb light of different wavelengths, and wherein the waveguide comprising the one or more nanostructures that absorb the shortest wavelength light is located closest to a light source and the waveguide comprising the one or more nanostructures that absorb the longest wavelength light is located farthest from the light source.

69. A composite material, comprising:

a plurality of nanowires; and

a small molecule or molecular matrix or a matrix comprising at least one polymer, which small molecule or molecular matrix or components thereof or which matrix comprising at least one polymer or components thereof are used to orient the nanowires.

70. A composite material, comprising one or more nanostructures and a polymeric matrix comprising a polysiloxane.

71. A composite material as in claim **70**, wherein the matrix comprises polydimethylsiloxane.

72. A composite material as in claim **70**, wherein the matrix comprises a copolymer between dimethylsiloxane and another siloxane.

73. A composite material as in claim **70**, wherein the one or more nanostructures comprise one or more of: nanowires, nanocrystals, branched nanowires, or nanotetrapods.

74. A composite material as in claim **70**, wherein the one or more nanostructures comprise one or more of: a metal, a ferroelectric material, a ferroelectric ceramic material, a perovskite-type material, a KDP-type material, a TGS-type material, a fluorescent material, a semiconducting material, a material comprising a first element selected from group 2 of the periodic table and a second element selected from group 16, a material comprising a

first element selected from group 12 and a second element selected from group 16, a material comprising a first element selected from group 13 and a second element selected from group 15, a material comprising a group14 element, or an alloy or a mixture thereof.

75. A composite material as in claim **74**, wherein the one or more nanostructures comprise one or more of: $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, tri-glycine sulfate, tri-glycine selenate, ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, MgS, MgSe, MgTe, CaS, CaSe, CaTe, SrS, SrSe, SrTe, BaS, BaSe, BaTe, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, Ge, Si, PbS, PbSe, PbTe, AlS, AlP, AlSb, or an alloy or a mixture thereof.

76. A composite material as in claim **70**, further comprising at least one surfactant or at least one solvent.

77. A shaped article of a composite material according to claim **70**.

78. An LED, laser, waveguide, or amplifier comprising a composite as in claim **70**.

79. A composite material, comprising:

a small molecule or molecular matrix or a matrix comprising at least one organic polymer or inorganic glass; and

one or more branched nanowires, one or more inorganic nanowires, or a combination thereof, wherein the one or more inorganic nanowires are selected from the group consisting of semiconducting inorganic nanowires and ferroelectric inorganic nanowires, and wherein the one or more inorganic nanowires have an aspect ratio greater than about 10.

80. A composite material as in claim **79**, wherein the one or more branched nanowires comprise one or more nanotetrapods.

81. A composite material as in claim **79**, wherein the composite material comprises one or more inorganic nanowires and the one or more inorganic nanowires comprise a plurality of inorganic nanowires.

82. A composite material as in claim **81**, wherein the orientation of the nanowires is substantially nonrandom.

83. A composite material as in claim **82**, wherein the composite material is formed into a thin film, the thin film being substantially free of strain.

84. A composite material as in claim **82**, wherein the composite material is formed into a highly-strained stretched film.

85. A composite material as in claim **82**, wherein the composite material is formed into a thin film within which a majority of the nanowires have their long axes oriented substantially parallel to a surface of the film.

86. A composite material as in claim **82**, wherein the composite material is formed into a thin film within which a majority of the nanowires are oriented such that each has its long axis more nearly perpendicular than parallel to a surface of the film.

87. A composite material as in claim **82**, wherein the composite material is formed into a thin film within which a majority of the nanowires are oriented such that each has its long axis substantially perpendicular to a surface of the film.

88. A composite material as in claim **79**, wherein the ferroelectric inorganic nanowires comprise one or more of: ferroelectric ceramic, perovskite-type, KDP-type, or TGS-type nanowires.

89. A composite material as in claim **88**, wherein the ferroelectric inorganic nanowires comprise one or more of: $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, tri-glycine sulfate, or tri-glycine selenate nanowires.

90. A composite material as in claim **79**, wherein the semiconducting inorganic nanowires comprise one or more of: a material comprising a first element selected from group 2 of the periodic table and a second element selected from group 16, a material comprising a first element selected from group 12 and a second element selected from group 16, a material

comprising a first element selected from group 13 and a second element selected from group 15, a material comprising a group14 element, or an alloy or a mixture thereof.

91. A composite material as in claim **90**, wherein the semiconducting inorganic nanowires comprise one or more of: ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, MgS, MgSe, MgTe, CaS, CaSe, CaTe, SrS, SrSe, SrTe, BaS, BaSe, BaTe, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, Ge, Si, PbS, PbSe, PbTe, AlS, AlP, AlSb, or an alloy or a mixture thereof.

92. A composite material as in claim **79**, wherein the small molecule or molecular matrix comprises one or more of: N,N'-diphenyl-N,N'-bis (3-methylphenyl)-(1,1'biphenyl)-4,4'-diamine); (3-(4-biphenyl)-4-phenyl-5-tert-butylphenyl-1,2,4-triazole); tris-(8-hydroxyquinoline) aluminum; benzoic acid; phthalic acid; benzoin; hydroxyphenol; nitrophenol; chlorophenol; chloroaniline; or chlorobenzoamide.

93. A composite material as in claim **79**, wherein the at least one organic polymer comprises one or more of: a thermoplastic polymer, a polyolefin, a polyester, a polysilicone, a polyacrylonitrile resin, a polystyrene resin, polyvinyl chloride, polyvinylidene chloride, polyvinyl acetate, a fluoroplastic, a thermosetting polymer, a phenolic resin, a urea resin, a melamine resin, an epoxy resin, a polyurethane resin, an engineering plastic, a polyamide, a polyacrylate resin, a polyketone, a polyimide, a polysulfone, a polycarbonate, a polyacetal, a liquid crystal polymer, a main chain liquid crystal polymer, poly(hydroxynapthoic acid), a side chain liquid crystal polymer, poly <n-((4'(4"-cyanphenyl)phenoxy)alkyl)vinyl ether>, a conductive polymer, poly(3-hexylthiophene), poly[2-methoxy, 5-(2'-ethyl-hexyloxy)-p-phenylene-vinylene], poly(phenylene vinylene), or polyaniline.

94. A composite material as in claim **79**, wherein the one or more inorganic nanowires have an average diameter between about 2 nm and about 100 nm, between about 2 nm and about 5 nm, or between about 10 nm and about 50 nm.

95. A composite material as in claim **79**, wherein the one or more inorganic nanowires have an aspect ratio between about 10 and about 10,000, between about 20 and about 10,000, between about 50 and about 10,000, or between about 100 and about 10,000.

96. A composite material, comprising:

a plurality of nanostructures; and

a small molecule or molecular matrix, a glassy or crystalline inorganic matrix, or a matrix comprising at least one polymer,

wherein the composite material is distributed on a first layer of a material that conducts substantially only electrons or substantially only holes.

97. A composite material as in claim **96**, wherein the composite and the first layer are in contact.

98. A composite material as in claim **96**, wherein the composite and the first layer are separated by a second layer, the second layer comprising a material that conducts electrons or holes or both electrons and holes.

99. A composite material as in claim **96**, wherein the first layer is distributed on an electrode.

100. A composite material as in claim **99**, wherein the first layer and the electrode are in contact.

101. A composite material as in claim **99**, wherein the first layer and the electrode are separated by a third layer, the third layer comprising a material that conducts electrons or holes or both electrons and holes.

102. A composite material, comprising:

a matrix; and

one or more nanostructures, the one or more nanostructures each comprising a core and at least one shell, the core comprising a first semiconducting material having a conduction band and a valence band, the shell comprising a second semiconducting material having a conduction band and a valence band, and the first and second materials having a type I band offset.

103. A composite material as in claim **102**, wherein the conduction band of the first material is lower than the conduction band of the second material, and the valence band of the first material is higher than the valence band of the second material.

104. A composite material as in claim **102**, wherein the conduction band of the first material is higher than the conduction band of the second material, and the valence band of the first material is lower than the valence band of the second material.

105. A composite material as in claim **102**, wherein the matrix comprises at least one polymer, comprises at least one glass, or is a small molecule or molecular matrix.

106. A composite material as in claim **102**, wherein the matrix conducts both electrons and holes, conducts substantially only holes, conducts substantially only electrons, is semiconducting, or is substantially nonconductive.

107. A composite material as in claim **102**, wherein the one or more nanostructures comprise one or more of: nanocrystals, nanowires, branched nanowires, or nanotetrapods.

108. A composite material, comprising:

one or more nanostructures comprising a first semiconducting material having a conduction band and a valence band; and

a matrix comprising a second semiconducting material having a conduction band and a valence band, wherein the first and second materials have a type I band offset.

109. A composite material as in claim **108**, wherein the conduction band of the first material is lower than the conduction band of the second material, and the valence band of the first material is higher than the valence band of the second material.

110. A composite material as in claim **108**, wherein the conduction band of the first material is higher than the conduction band of the second material, and the valence band of the first material is lower than the valence band of the second material.

111. A composite material as in claim **108**, wherein each nanostructure comprises substantially a single material, the single material being the first material.

112. A composite material as in claim **108**, wherein each nanostructure comprises a core and at least one shell, the core comprising the first material.

113. A composite material as in claim **108**, wherein each nanostructure comprises a core and at least one shell, the shell comprising the first material.

114. A composite material as in claim **108**, wherein the matrix comprises at least one polymer, comprises at least one glass, or is a small molecule or molecular matrix.

115. A composite material as in claim **108**, wherein the one or more nanostructures comprise one or more of: nanocrystals, nanowires, branched nanowires, or nanotetrapods.

116. A composite material, comprising:

a matrix; and

one or more nanostructures, the one or more nanostructures each comprising a core and at least one shell, the core comprising a first semiconducting material having a conduction band and a valence band, the shell comprising a second semiconducting material having a conduction band and a valence band, and the first and second materials having a type II band offset.

117. A composite material as in claim **116**, wherein the conduction band of the first material is lower than the conduction band of the second material, and the valence band of the first material is lower than the valence band of the second material.

118. A composite material as in claim **116**, wherein the conduction band of the first material is higher than the conduction band of the second material, and the valence band of the first material is higher than the valence band of the second material.

119. A composite material as in claim **116**, wherein the matrix comprises at least one polymer, comprises at least one glass, or is a small molecule or molecular matrix.

120. A composite material as in claim **116**, wherein the matrix conducts both electrons and holes, conducts substantially only holes, conducts substantially only electrons, is semiconducting, or is substantially nonconductive.

121. A composite material as in claim **116**, wherein the one or more nanostructures comprise one or more of: nanocrystals, nanowires, branched nanowires, or nanotetrapods.

122. A composite material, comprising:

one or more nanostructures comprising a first semiconducting material having a conduction band and a valence band; and

a matrix comprising a second semiconducting material having a conduction band and a valence band, wherein the first and second materials have a type II band offset.

123. A composite material as in claim **122**, wherein the conduction band of the first material is lower than the conduction band of the second material, and the valence band of the first material is lower than the valence band of the second material.

124. A composite material as in claim **122**, wherein the conduction band of the first material is higher than the conduction band of the second material, and the valence band of the first material is higher than the valence band of the second material.

125. A composite material as in claim **122**, wherein each nanostructure comprises substantially a single material, the single material being the first material.

126. A composite material as in claim **122**, wherein each nanostructure comprises a core and at least one shell, the core comprising the first material.

127. A composite material as in claim **122**, wherein each nanostructure comprises a core and at least one shell, the shell comprising the first material.

128. A composite material as in claim **127**, wherein the core comprises a third semiconducting material having a conduction band and a valence band, the third and first materials having a type II band offset.

129. A composite material as in claim **122**, wherein the matrix comprises at least one polymer, comprises at least one glass, or is a small molecule or molecular matrix.

130. A composite material as in claim **122**, wherein the one or more nanostructures comprise one or more of: nanocrystals, nanowires, branched nanowires, or nanotetrapods.

131. A composite material, comprising:

a plurality of nanostructures; and

a small molecule or molecular matrix or a matrix comprising at least one polymer, the at least one polymer or constituents of the small molecule or molecular matrix having an affinity for at least a portion of a surface of the nanostructures.

132. A composite material, comprising:

a plurality of nanostructures, wherein the nanostructures each comprise one or more surface ligands; and

a small molecule or molecular matrix or a matrix comprising at least one polymer, the at least one polymer or constituents of the small molecule or molecular matrix having an affinity for the one or more surface ligands.

133. A composite material as in claim **132**, wherein the one or more surface ligands each comprise at least one small molecule found in the small molecule or molecular matrix or a derivative thereof or at least one monomer found in the at least one polymer or a derivative thereof.

134. A composite material as in claim **132**, wherein the one or more surface ligands each comprise at least one functional group selected from the group consisting of: an amine, a phosphine, a phosphine oxide, a phosphonate, a phosphonite, a phosphinic acid, a phosphonic acid, a thiol, an alcohol, and an amine oxide.

135. A composite material, comprising: one or more ferroelectric nanowires or one or more ferroelectric nanoparticles and a small molecule or molecular matrix or a matrix comprising one or more polymers.

136. A composite material as in claim **135**, wherein the one or more ferroelectric nanowires or nanoparticles comprise one or more of: ferroelectric ceramic, perovskite-type, KDP-type, or TGS-type nanowires or nanoparticles.

137. A composite material as in claim **136**, wherein the one or more ferroelectric nanowires or nanoparticles comprise one or more of: $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, tri-glycine sulfate, or tri-glycine selenate nanowires or nanoparticles.

138. A composite material as in claim **135**, wherein the one or more polymers comprise one or more of: an inorganic polymer, a polysiloxane, a polycarbonessiloxane, a polyphosphazene, an organic polymer, a thermoplastic polymer, a polyolefin, a polyester, a polysilicone, a polyacrylonitrile resin, a polystyrene resin, polyvinyl chloride, polyvinylidene chloride, polyvinyl acetate, a fluoroplastic, a thermosetting polymer, a

phenolic resin, a urea resin, a melamine resin, an epoxy resin, a polyurethane resin, an engineering plastic, a polyamide, a polyacrylate resin, a polyketone, a polyimide, a polysulfone, a polycarbonate, a polyacetal, a liquid crystal polymer, a main chain liquid crystal polymer, poly(hydroxynapthoic acid), a side chain liquid crystal polymer, or poly <n-((4'(4"-cyanphenyl)phenoxy)alkyl)vinyl ether>.

139. A composite material as in claim **135**, wherein the small molecule or molecular matrix comprises one or more of: N,N'-diphenyl-N,N'-bis (3-methylphenyl)-(1,1'biphenyl)-4,4'-diamine); (3-(4-biphenyl)-4-phenyl-5-tert-butylphenyl-1,2,4-triazole); tris-(8-hydroxyquinoline) aluminum; benzoic acid; phthalic acid; benzoin; hydroxyphenol; nitrophenol; chlorophenol; chloroaniline; or chlorobenzoamide.

140. A composite material as in claim **135**, wherein the matrix comprises one or more additives.

141. A composite material as in claim **140**, wherein the one or more additives comprise one or more of: a surfactant, a plasticizer, a catalyst, an antioxidant, or a strengthening fiber.

142. A composite material as in claim **135**, wherein the one or more ferroelectric nanowires or nanoparticles are included in sufficient quantity that the composite material has a dielectric constant of at least about 2, at least about 5, or at least about 10.

143. A composite material as in claim **135**, wherein the one or more ferroelectric nanowires or nanoparticles are included in the composite in an amount greater than 0% and less than about 90% by volume.

144. A composite material as in claim **135**, wherein the one or more ferroelectric nanowires have an average diameter between about 2 nm and about 100 nm, between about 2 nm and about 5 nm, or between about 10 nm and about 50 nm.

145. A composite material as in claim **135**, wherein the one or more ferroelectric nanowires have an aspect ratio between about 1.5 and about 10000, between about 1.5 and about 10, between about 10 and about 20, between about 20 and about 50, between about 50 and about 10,000, or between about 100 and about 10,000.

146. A composite material as in claim **135**, wherein the one or more ferroelectric nanoparticles have an average diameter less than about 200 nm.

147. A composite material as in claim **135**, wherein the one or more ferroelectric nanoparticles have an aspect ratio between about 0.9 and about 1.2.

148. A film formed from a composite material as described in claim **135**.

149. A substrate to which a composite material as in claim **135** has been applied.

150. A substrate as in claim **149**, wherein the substrate comprises silicon, glass, an oxide, a metal, or a plastic.

151. A composition comprising particles of the composite material as in claim **135**, at least one solvent, and at least one glue agent.

152. A composition as in claim **151**, wherein the particles of the composite material have an average diameter between about 20 nm and about 20 micrometers.

153. A composition as in claim **151**, wherein the glue agent is a polymer.

154. A film formed from a composition as described in claim **151**.

155. A composition comprising one or more ferroelectric nanowires or nanoparticles, at least one solvent, and one or more polymers.

156. A composition as in claim **155**, wherein the one or more ferroelectric nanowires or nanoparticles comprise one or more of: ferroelectric ceramic, perovskite-type, KDP-type, or TGS-type nanowires or nanoparticles.

157. A composition as in claim **156**, wherein the one or more ferroelectric nanowires or nanoparticles comprise one or more of: $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, tri-glycine sulfate, or tri-glycine selenate nanowires or nanoparticles.

158. A composition as in claim **155**, wherein the one or more polymers comprise one or more of: an inorganic polymer, a polysiloxane, a polycarbonessiloxane, a polyphosphazene,

an organic polymer, a thermoplastic polymer, a polyolefin, a polyester, a polysilicone, a polyacrylonitrile resin, a polystyrene resin, polyvinyl chloride, polyvinylidene chloride, polyvinyl acetate, a fluoroplastic, a thermosetting polymer, a phenolic resin, a urea resin, a melamine resin, an epoxy resin, a polyurethane resin, an engineering plastic, a polyamide, a polyacrylate resin, a polyketone, a polyimide, a polysulfone, a polycarbonate, a polyacetal, a liquid crystal polymer, a main chain liquid crystal polymer, poly(hydroxynapthoic acid), a side chain liquid crystal polymer, or poly <n-((4'(4"-cyanphenyl)phenoxy)alkyl)vinyl ether>.

159. A composition as in claim **155**, wherein the one or more ferroelectric nanowires have an average diameter between about 2 nm and about 100 nm, between about 2 nm and about 5 nm, or between about 10 nm and about 50 nm.

160. A composition as in claim **155**, wherein the one or more ferroelectric nanowires have an aspect ratio between about 1.5 and about 10000, between about 1.5 and about 10, between about 10 and about 20, between about 20 and about 50, between about 50 and about 10,000, or between about 100 and about 10,000.

161. A composition as in claim **155**, wherein the one or more polymers are soluble in the at least one solvent.

162. A composition as in claim **155**, wherein the one or more polymers comprise emulsion polymerized polymer particles suspended in the at least one solvent.

163. A composition as in claim **162**, further comprising at least one glue agent.

164. A composition as in claim **155**, wherein the one or more polymers comprise oligomers soluble in the at least one solvent.

165. A composition as in claim **164**, further comprising at least one cross-linking agent.

166. A composition as in claim **155**, wherein the at least one solvent is water or an organic solvent.

167. A composition as in claim **155**, further comprising at least one surfactant.

168. A composition as in claim **167**, wherein the at least one surfactant is selected from the group consisting of a cationic surfactant, an anionic surfactant, and a nonionic surfactant.

169. A composition as in claim **155**, further comprising at least one humectant.

170. A composition as in claim **169**, wherein the at least one humectant is selected from the group consisting of a glycol, a diol, a sulfoxide, a sulfone, an amide, and an alcohol.

171. A composition as in claim **155**, wherein the composition is a liquid suitable for use as an inkjet printing ink or a paste suitable for use as a screen printing ink.

172. A composition as in claim **155**, wherein the composition has a consistency that makes the composition suitable for applying to a surface by brushing or by spraying.

173. A substrate to which a composition as in claim **155** has been applied.

174. A substrate as in claim **173**, wherein the substrate comprises silicon, glass, an oxide, a metal, or a plastic.

175. A film formed from a composition as described in claim **155**.

176. A composition, comprising one or more ferroelectric nanowires or nanoparticles and at least one monomeric precursor of at least one polymer.

177. A composition as in claim **176**, wherein the ferroelectric nanowires or nanoparticles comprise one or more of: ferroelectric ceramic, perovskite-type, KDP-type, or TGS-type nanowires or nanoparticles.

178. A composition as in claim **177**, wherein the ferroelectric nanowires or nanoparticles comprise one or more of: $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, tri-glycine sulfate, or tri-glycine selenate nanowires or nanoparticles.

179. A composition as in claim **176**, further comprising at least one solvent.

180. A composition as in claim **176**, further comprising at least one catalyst.

181. A substrate to which a composition as in claim **176** has been applied.

182. A substrate as in claim **181**, wherein the substrate comprises silicon, glass, an oxide, a metal, or a plastic.

183. A film formed from a composition as described in claim **176**.

184. A method of making a composite material, the method comprising:

preparing one or more branched nanowires or one or more inorganic nanowires, wherein the one or more inorganic nanowires are selected from the group consisting of semiconducting inorganic nanowires and ferroelectric inorganic nanowires, and wherein the one or more inorganic nanowires have an aspect ratio greater than about 10; and

combining the one or more branched nanowires, one or more inorganic nanowires, or a combination thereof and at least one organic polymer or inorganic glass or precursors of a small molecule or molecular matrix.

185. A method of making a composite material, the method comprising:

preparing one or more ferroelectric nanowires or nanoparticles; and

combining the one or more ferroelectric nanowires or nanoparticles and at least one polymer or precursors of a small molecule or molecular matrix.

186. The method of claim **185**, wherein the one or more ferroelectric nanowires or nanoparticles comprise one or more of: ferroelectric ceramic, perovskite-type, $BaTiO_3$, $SrTiO_3$, $CaTiO_3$, $KNbO_3$, $PbTiO_3$, $LiTiO_3$, $LiTaO_3$, $LiNbO_3$, $Ba_{(1-x)}Ca_xTiO_3$ where x is between 0 and 1, $PbTi_{(1-x)}Zr_xO_3$ where x is between 0 and 1, KDP-type, KH_2PO_4, KD_2PO_4, RbH_2PO_4, RbH_2AsO_4, KH_2AsO_4, GeTe, TGS-type, tri-glycine sulfate, or tri-glycine selenate nanowires or nanoparticles.

187. The method of claim **185**, wherein the at least one polymer comprises one or more of: an inorganic polymer, a polysiloxane, a polycarbonessiloxane, a polyphosphazene, an organic polymer, a thermoplastic polymer, a polyolefin, a polyester, a polysilicone, a polyacrylonitrile resin, a polystyrene resin, polyvinyl chloride, polyvinylidene chloride, polyvinyl acetate, a fluoroplastic, a thermosetting polymer, a phenolic resin, a urea resin, a melamine resin, an epoxy resin, a polyurethane resin, an engineering plastic, a polyamide, a polyacrylate resin, a polyketone, a polyimide, a polysulfone, a polycarbonate, a polyacetal,

a liquid crystal polymer, a main chain liquid crystal polymer, poly(hydroxynapthoic acid), a side chain liquid crystal polymer, or poly <n-((4'(4"-cyanphenyl)phenoxy)alkyl)vinyl ether>.

188. The method of claim **185**, wherein the one or more ferroelectric nanowires or nanoparticles and the at least one polymer are combined with one or more additives.

189. The method of claim **188**, wherein the one or more additives comprise one or more of: a surfactant, a plasticizer, a catalyst, an antioxidant, or a strengthening fiber.

190. The method of claim **185**, wherein the one or more ferroelectric nanowires or nanoparticles are included in sufficient quantity that the composite material has a dielectric constant of at least about 2, at least about 5, or at least about 10.

191. The method of claim **185**, wherein the one or more ferroelectric nanowires or nanoparticles are included in the composite in an amount greater than 0% and less than about 90% by volume.

192. A method of making a composition, the method comprising:

preparing particles of a composite material as in claim **135**; and

combining the particles with at least one solvent and at least one glue agent.

193. A method of making a composition, the method comprising:

preparing one or more ferroelectric nanowires or nanoparticles; and

combining the one or more nanowires or nanoparticles with at least one solvent and one or more polymers.

194. The method of claim **193**, wherein the one or more polymers are soluble in the at least one solvent.

195. The method of claim **193**, wherein the one or more polymers comprise emulsion polymerized particles capable of being suspended in the at least one solvent.

196. The method of claim **193**, wherein the one or more polymers comprise oligomers soluble in the at least one solvent.

197. A method of making a composition, the method comprising:

preparing one or more ferroelectric nanowires or nanoparticles; and

combining the one or more nanowires or nanoparticles with at least one monomeric precursor of at least one polymer.

198. A method of making a composite material, the method comprising:

preparing one or more nanostructures; and

incorporating the preformed nanostructures into a polymeric matrix comprising a polysiloxane.